ON THE EARLIER STUDIES OF THE MEDICAL CURRICULUM.

ADDRESS

TO THE

MEDICAL STUDENTS

AT THE OPENING OF THE WINTER SESSION,
UNIVERSITY OF GLASGOW,

TUESDAY, OCTOBER 29, 1878.

BY

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ADDRESS.

"To make a man think for himself is doing him far higher service than giving him much instruction."—*Charles Babbage.*

It has been the custom in this University to open the medical department by a special address, and it has fallen to my lot to give it on this occasion. Permit me in the first place, on behalf of my colleagues, to offer you a hearty welcome, and to express the hope that the academic year on which we are about to enter may be eminently successful. This will depend to a large extent upon ourselves; upon the cordial co-operation that ought to exist between teachers and students; and upon the amount of earnestness and intelligence which we bring to bear upon our work.

I have had considerable difficulty in selecting a topic on which to address you. This has not arisen from want of material, but from the difficulty in choosing a subject likely to interest all my hearers. Some of you are about to begin the study of medicine, others have advanced a considerable distance, whilst many are now

not far from the time of graduation. Consequently, the science of medicine and the practical work of the profession present varied aspects to many of you, so that what would interest one class might have little significance to another. I shall, therefore, to-day address myself chiefly to those who are about to begin the study of medicine, or who are still in the early years of the curriculum, leaving any other remarks I may have to make to the time when I shall have the opportunity of addressing the graduates in July next.

It would be useless to attempt to inquire into the motives which have induced you to choose the medical profession as the work of your life. Many probably have had the path chosen for them without much consideration on the part of friends as to any special aptitude they may or may not possess for the work, others have chosen it as promising a means of earning an honourable livelihood, whilst some may have been attracted to it by the love of science and by the prospect of the scientific training which the curriculum of study affords. But whatever may have induced you to enter upon the study of medicine, it is your duty now to apply yourself to the work with all diligence and to miss no opportunity of training yourselves for the important public duties you will afterwards have to perform. If you have only four years to devote to study before graduation, the field of study now traversed by the medical student is so extensive as to demand all your

time and all your energies. You should always keep this in view and work steadily from the beginning. I insist strongly upon this, as I know it is not an uncommon practice for students of medicine to lose a good deal of time during the first year of the curriculum. Released from elementary study, treated in medical classes with perhaps more consideration than he may have been accustomed to, thrown upon his own resources, already regarded at home as an embryonic doctor entitled to some deference, with examinations apparently far in the distance, the student is accustomed to let time slip away with little or no progress made in the acquisition of knowledge. From an intimate acquaintance with students of medicine for at least ten years, I have formed the opinion that this arises to a considerable extent from the fact that they think of each subject in the curriculum too much as if it were isolated, as if it had no direct connection with the profession, instead of regarding it as part of the training which experience has led us to adopt as the best for a medical man. He is apt to suppose also that the earlier studies of the curriculum are less important than those towards its close, and that, therefore, he can afford to pay less attention to them. Thus, the student may feel little or no interest in the study of biological science, or in the more technical details of anatomy or of chemistry, because he does not see any bearing which knowledge of this kind has on the detection or treatment of

disease. Now, I think that it is vain to attempt to dispel this illusion by trying to show that a knowledge of certain botanical or zoological facts, or of many of the minute details of anatomy, or of chemistry, are necessary in the practice of medicine or of surgery. It is a fact that much of this knowledge may be forgotten, and that many men of great natural ability have acquired much distinction in the diagnosis and treatment of disease who have been singularly illiterate in this respect. If, however, you regard the course of education presented to you, not so much as a means of storing up an immense assemblage of facts as an intellectual training fitted to call forth those powers of observation and of correct reasoning which are essential to the successful detection and treatment of disease, then you will recognize the true relative importance of those branches of study to which I have alluded.

After you have graduated, what is to be the work of your life? The detection and the treatment of disease, and the advancement of the medical and surgical arts. You will observe that I recognize the advancement of his profession as part of the work of every medical man. I believe this view is held by many in the profession, but not nearly by all. Consequently it must be insisted on, and it is well that you should accept it even at the beginning of your studies. Every man is bound to do what he can to improve medicine and surgery, and to add to the general store of knowledge. By so doing,

he will live not for himself alone, but for others. The question then arises, How are you to be trained for this work? Experience has suggested a certain course of study the subjects of which may be grouped as follows:—(1) General knowledge, such as ought to be possessed by every well educated man; (2) Scientific knowledge, such as an acquaintance with botany, zoology, and chemistry; (3) A knowledge of anatomy, physiology, and pathology, the sciences which form the groundwork of medicine and surgery; (4) A knowledge of materia medica, or the physical, chemical, and physiological properties of the substances used as remedies; and (5) A special training in the diagnosis and treatment of disease, comprehended under the names of medicine, surgery, and obstetrics. In addition to all these, there is a course of instruction in medical jurisprudence, in which you will be taught how the medical man may aid the law in the detection of crime. Now, what I wish to point out is that all these branches of study are related to each other, and that each division may be regarded as preparatory to what follows. Permit me to make a few observations on each of these departments.

First, with regard to general education. There can be no doubt that the general education of the student of medicine is undergoing, from year to year, a marked improvement. This is shown by the quality of the papers now written by many candidates at the preliminary ex-

amination. Still we have by no means attained the excellence which is desirable. Many of the papers are good, but some are still so bad as inevitably to lead to the rejection of the candidate. I regard it as of great importance to maintain a high standard in the preliminary examination. It would be well if every candidate for the medical profession attended at least two years of the curriculum in Arts, including attendance at the class of natural philosophy, or had a degree in Arts, but failing this, the preliminary examination ought to represent something equivalent. Although this may appear hard, still I believe it would ultimately improve the social position of the profession. I think also that special prominence should be given to the study of English, more especially as regards composition. Many students do themselves great injustice in professional examinations by neglecting this accomplishment. They often have a considerable amount of knowledge, but it is set forth without any attempt at arrangement or clearness of expression. Some years ago I held an official position, in which I received many letters from candidates for the medical profession. Not unfrequently they were such, both in form and haziness of expression, as would have puzzled and astonished any man of business, and I sometimes tried to imagine the kind of report which some of these gentlemen would have submitted, supposing they had been asked to write one by the directors of a public institution. Such a report, I fear, would not have impressed the public with a high idea of

their literary attainments. I would therefore strongly urge you to cultivate clearness of expression, and to aim at a style of composition which you can handle with ease. This will help you in after-life, when you may be placed in positions of public responsibity, in which you may have to express your opinions in writing for the guidance of those who will look to you for advice.

Second, with reference to education in science. It has always been the glory of the medical profession that it has been closely linked with scientific progress. Science, in many of its departments, took its origin from the researches of medical men. A desire to cure disease led men, even in early ages, to study the properties of matter, to investigate the phenomena of nature, and to describe and classify the endless varieties of living beings. As time went on, and the sciences became more and more differentiated, medical men constituted a large proportion of investigators in each department. This is abundantly shown by perusing the earlier transactions of the learned societies of Europe. Naturally, medical men have devoted special attention to the biological sciences, and it is only in very recent times that non-professional specialists have been found amongst their cultivators. Such being the case, education in science came to be regarded, at least by our Universities, as part of the training of the student of medicine. The sciences specially attended to have been botany, zoology, and chemistry. In this country, various examining boards have never required any examination in botany and

zoology, and consequently many men have entered the profession ignorant of these sciences. A knowledge of chemistry, from its more obvious relation to the medical art, has been required by the great majority of examining boards, but men have been in the profession who knew little or nothing of the most elementary chemical facts. One of the most valuable services rendered to medical education by the Scotch Universities has been the importance they have always attached to scientific studies. They have sent forth from year to year men who have had a considerable acquaintance with biology and chemistry. Many of these, leaving the paths of medical or surgical practice, have devoted their lives to science and contributed to its progress; whilst others, settling here and there over the land or in our colonies, have, by their obvious acquaintance with scientific facts, done good service by showing that the physician or surgeon was not a narrow specialist, but one who took an intelligent view of all natural phenomena, and who had a deep sympathy with scientific progress. For my own part, I deeply regret the tendency now shown by some reformers in medical education to separate a training in biological science from the ordinary curriculum of the profession. It has been proposed to place the biological sciences among the preliminary subjects. This would, I think, be a grave mistake. No one desires more keenly than I do to see biological science taught as a branch of a good general education suitable for all classes of the community, but I think the knowledge of

biological science required by a well-educated medical man ought to be something more than mere general knowledge. He ought to have a training in the methods of biological science; his powers of observation, of classification, of generalization, of accurate description, ought to be cultivated, and I know of no better way of doing this than by the study of biology in its various departments. Place these subjects in a separate category if you will; let the student study them and pass an examination on them prior to the beginning of medical studies properly so called, but do not remove them from the medical curriculum, nor render attendance on special courses of instruction optional.

Training in general biology will prepare the student for entering on a consideration of many of the problems of anatomy and physiology. The morphological studies of the botanist and zoologist lead the way to an intelligent comprehension of function. Morphology, also, no doubt is the correct basis for scientific classification; but it derives its importance, in my opinion, as a branch of medical training by preparing for physiology, or the science of function. Again, the systemic study of comparative anatomy, which is the basis of zoology, helps one to appreciate, to fix in the memory, and to take an intellectual grasp of many of the facts of human anatomy. The structure of the human body, a knowledge of which is the very groundwork of all the other departments of medical study, is after all only the structure of one animal. It is possible to study

it in an isolated way ; it is possible for a man to know it nearly as thoroughly as he might know the mechanism of a watch ; but this mode of studying it, though good enough for some practical purposes, is eminently unsatisfactory and unphilosophical. How much more interesting it becomes when illuminated by the light of comparative anatomy, and when the student feels that he has laid out before him a great plan of structure, modified here and there by special circumstances for special purposes ! But the botanist and zoologist do not deal with morphology alone. They also treat of the physiology or functions of plants and animals, and thus they prepare the way for studying the more complex physiology of man. Comparative physiology is the co-relative of comparative anatomy. Neither are taught by one man, but by several. They take a wide sweep, and a knowledge of their range gives an intelligent and philosophical view of structure and function, which could not otherwise be obtained.

The importance of the study of chemistry is so obvious that little need be said to recommend it, more especially as this formed the subject of the able address of my colleague, Professor Ferguson, last year. Chemistry leads the student at once to the root of the matter, and asks him to study the nature and properties of the elements which form all things ; it leads him on to the study of the more important compounds ; it shows how these are built up into still more complex substances ; it trains the mind to habits of accuracy, inasmuch as many of its most fundamental con-

ceptions depend on scrupulous attention to weight; it accustoms one to the methods of synthesis and of analysis which are applicable to many other departments of knowledge; and it gradually unfolds a series of theories and hypotheses to explain chemical reactions, and gives us a glimpse into that world of molecular movements which are the hidden causes of chemical and physical phenomena. So far, the study of chemistry is an intellectual training of a high character; but, in addition, the science is a storehouse of facts regarding air, water, food, and substances used as remedies, with which every medical man must be acquainted. The department of organic chemistry is also of high importance to the student of medicine, more especially in the field of what is known as physiological chemistry, or the chemistry of the processes going on in the body. The substances introduced into the body as food, those thrown out of it as excretions, and those which form its tissues and fluids, are mostly of complex chemical composition. To understand their true nature and affinities, or to see how they may be built up or broken down in the body, in health or in disease, one must be acquainted with the general principles of organic chemistry. Physiological chemistry is still an obscure department of the science, but it is becoming less and less so every year. There are many able men working on the Continent at some of its problems, and we may feel assured that every advance made will help us in understanding physiological processes, and how these may be affected in disease. The time is not far distant

when a skilled chemist, who has also had a training in medical studies, will be attached to all our great hospitals, and whose duty it will be to analyse for the physicians and surgeons morbid fluids or tissues. At present we know very little of the chemical actions connected with pathological changes, but it is a department of science which, in my opinion, is likely to reward those who have the courage to face its difficulties.

At this point I wish to remark that the study of general physics does not receive the amount of attention in our medical curriculum which it deserves. The knowledge of physics required in the preliminary examination is elementary, and not sufficient for the student when he approaches the subject of physiology. In describing the mechanism of the body, whilst we no doubt base our remarks on morphology, we nevertheless find it necessary constantly to refer to physical phenomena and to physical laws. Animal movements involve problems in mechanics, the study of contractility, or of nervous actions, necessitates a general knowledge of electrical phenomena and of electrical appliances, the circulation of the blood is that of a fluid through elastic and contractile tubes, driven onwards by the intermittent movements of the heart, the eye is a camera, and the ear is an acoustic apparatus. As a teacher of physiology, I have often been embarrassed by the student's want of information regarding physics, and my time has been taken up explaining elementary facts when I ought to have been presenting the physiological side of

the question. What is the remedy? It is not, in my opinion, difficult to find. I think a course of experimental physics should be delivered to students of medicine during their first summer session. If illustrated largely by demonstration and experiment, it would be highly interesting, and it would not be felt to be a great increase to the work of the student. I sincerely hope that arrangements may be made in our University for the delivery of such a course, as it would undoubtedly be for the benefit of our students of medicine.

I now come to the next stage of our progress. Suppose a student has a general acquaintance with biology, chemistry, and physics, or has had what we may term his training in general science, he is now prepared for the special study of anatomy, physiology, and pathology. These three form a basis upon which medicine and surgery rest. They are related to each other in the order in which I have mentioned them. Anatomy, the science of structure, prepares the way for physiology and pathology; and just in proportion as a student masters the details of anatomy will he be able to enter upon an intelligent study of the problems of physiology and of pathology. For this reason, he is required to devote more time to the study of anatomy than to any other subject, and he is presumed to have at least a general acquaintance with the structure of the body before he begins the study of its functions. Anatomy is a heavy study to some men and not so to

others. It will be so to the man who endeavours to acquire a knowledge of it merely by reading books; it will over-tax his memory and crowd his mind with a multitude of ill-arranged facts; but it will not be uninteresting to the man who strives after a practical acquaintance with it, to one who during the first two years of his medical studies spends much time in the dissecting room. Here he will gradually so become acquainted with the facts as to make them part of himself; he will become familiar with them without burdening the memory. This is the kind of anatomical knowledge towards which you should strive, and which will be of the greatest service to you in your after-life. I can recal two maxims, taught by the late Professor Goodsir whilst I was a student of anatomy, and I mention them to you because I found that attention to them lightened the labour of anatomical study and shed a lustre around accumulations of facts which would otherwise have been uninteresting and uninviting. The first was, never to conclude that I knew any point of anatomical detail, until I could either picture it to my mind, that is, make a mental image of it, or until I could sketch its outlines with a pencil and paper. Try, whilst studying the relations of organs, or of vessels, or of nerves to see the real thing and to impress its picture on the mind. Sometimes this may require repeated effort, but after it has been once fixed, you can recal it at any moment and see it with the "anatomical eye."

The other maxim was to endeavour to associate structure with function, and to be impressed with the conviction that there is no anatomical point too minute to have no physiological significance. The facets, surfaces, and foramina of bones, the form, size, and relative position of muscles, the distributions of nerves and vessels, and the form and structure of organs, have all a physiological meaning. We may not know it; it may have hitherto escaped the scrutiny of anatomists and physiologists, but it is there, and as we study we may search for it. With this thought, the study of anatomy becomes of the deepest interest. It ceases to be merely a matter of memory, and it becomes a philosophical study. I think the truth of this maxim is becoming more evident year by year, as physiologists and clinical physicians are gradually unravelling the intricate mechanism with which we have to deal. For example, the origin, course, and distribution of the cutaneous nerves were at one time of apparently small importance, but now we know that they may furnish the key to the explanation of many symptoms occurring in certain nervous diseases. In those days, when rapid advances are being made in the obscure region of diseases of the central nervous system, which are often accompanied by general or local changes in the sensibility of the skin, a knowledge of the anatomy of the cutaneous nerves may aid in diagnosis. This is only one example out of many that might be adduced. I would therefore strongly urge the

claims of anatomy upon you, and I trust that no impatient desire to become acquainted with the phenomena of disease at too early a period of your curriculum will prevent you from paying proper attention to anatomical work.

Closely related to anatomy, there is physiology, or the science which treats of function. Cultivated at first by anatomists, it was regarded for centuries merely as a branch of the parent science, and it is only in recent times that it has reached the position of a separate department.[1] During the past thirty years or so, physiology has made rapid progress, and it is now a study not only wide in extent, but having most important practical relations to the medical profession. Physiology deals with function; its province is to explain the operations going on in the living body. Its basis is morphology or structure, inasmuch as manifestly we must first know the structure of organs or systems before we can understand their functions. But its recent rapid progress has been mainly due to the increased application to physiology of those experimental methods which were hitherto mainly employed by the chemist and physicist. The introduction of these methods was due to a recognition of the fact that the operations going on in the living body are essentially the same in kind as those in the domain of chemistry and physics.

[1] For example, the chair which I have the honour to occupy in this University was founded only in 1839.

So long as they were believed to be different, so long as they were supposed to be due to the action of specific vital principles, or to properties inherent in tissues or in organs, they were deemed mysterious and beyond the sphere of the chemist or of the physicist. But, one by one, operations, once regarded as admitting of no explanation except that they were due to the action of a vital principle, have been shown to depend on physical conditions. The term vital, therefore, has now a limited significance, and probably, as science advances, its sphere will become more and more circumscribed. The application of a new method in science is invariably followed by a great extension of knowledge. Hence is it that in recent years numerous facts regarding the mechanism of the body have been brought to light by the labours of physiologists who have worked in their laboratories—weighing, measuring, registering—in the same spirit and often with the same appliances as the physicist or the chemist.

The inductions of physiology are founded upon facts collected from the following sources:—(1) *Morphological*, or those relating to structure; (2) *Experimental*, or those derived from experiments made on man or on the lower animals; (3) *Clinical* and *Pathological*, or those observed in the course of disease and by *post-mortem* examination. In collecting facts from these sources, the physiologist now makes use of all physical and chemical appliances within his reach. In the investiga-

tion of structure, whether healthy or as altered by morbid processes, he uses the microscope, with the aid of refined methods of histological research. Dense tissues are softened, soft tissues are hardened, opaque tissues are made transparent, the colourless elements of tissues are so coloured as to be rendered apparent, and vascular tissues are injected to exhibit the nature of the plexus. Again, the physiologist, whether he be the specialist in his laboratory, or the scientific physician or surgeon in the clinical wards, collects facts with the aid of instruments of precision. Movements are accurately registered, solids and fluids are analysed, variations of temperature are recorded with as much care as in the investigation of any physical phenomenon. Much might be said about the relative importance of those three modes of inquiry; but it would be useless. The point to recollect is that all three must contribute their share of facts, and that these facts must be sifted, classified, and harmonized before we can come to a just conclusion regarding any physiological problem. If the facts coming from one source contradict or cannot be harmonized with the facts supplied by the other two, we may be sure either that a mistake has been made as to the facts, or that we are imperfectly acquainted with the conditions. For example, the experiments of Hitzig, Fritsch, and Ferrier, in which they irritated by electrical currents the surface of the brain, and observed movements of definite groups of muscles, led them to form the opinion that there

are certain areas of grey matter on the surface of the brain, termed motor centres, whence emanate nervous currents to these muscles. This opinion was based on an extensive series of facts derived from experimental investigation. Has it been supported by anatomical and pathological observation? It cannot be said that anatomical facts have yet been collected in sufficient number to warrant us in asserting that nerve fibres may be traced from these so-called motor areas to these particular muscles. This department of minute anatomy, from inherent difficulties, is defective. We are not sufficiently acquainted with the course pursued by fibres in the brain; but at the same time, the anatomical facts known afford a strong presumption that there is a direct continuity of nerve fibres (with perhaps intercalated nerve cells) between the motor centre and the groups of muscles. Since the publication of these experimental researches, physicians all over the world have been contributing their quota of evidence. Many have met with cases of local paralysis or of convulsive attacks of muscles, affecting say the right arm, and after death in many of these cases, morbid changes have been found in the areas of grey matter supposed to be the centres for the groups of muscles affected. So firm is the belief of some physicians in the localization theory that they have ventured to predict, from a consideration of symptoms observed during life the area of brain-surface that would be found affected on examination after death, and in many cases their

predictions have been verified. On the other hand, cases have been recorded the facts of which do not harmonize with the theory. Until these can be satisfactorily explained, and until histological researches have shown the nervous path along which the influences travel, we must regard the statement that there are motor areas on the surface of the brain as not completely proved, but highly probable. This illustration will show you the sources from which physiological facts are derived. Some people, when they think of a physiologist, seem to have the experimental aspect of his work constantly before their minds, and consequently the terms physiologist and vivisector are to them almost synonymous. Such a notion betrays ignorance. There is a large amount of physiological work which does not involve experimentation on animals, but is of the same kind as that of the clinical physician or surgeon, or the physicist or the chemist. I make this remark with the view of correcting a widespread misapprehension. Experimentation on animals has been, and will be, one of the most powerful modes of research the physiologist possesses, but it is not the only method by which physiological knowledge is to be advanced. I think this view of the matter would tend to prevent that separation of the physiologist from the profession which has been going on during the past few years. Physiology, no doubt, is a science which may exist independently of the practical wants of the profession, just as geology is a science by itself, although

its data may be a practical guide to discovering the relations of coal beds. Whilst a purely utilitarian view of any science has always a cramping effect, a practical tendency is beneficial: it enlists a wider circle of supporters and cultivators, and it fulfils one of the great ends of science, the benefit of humanity. We may fairly regard every physician and surgeon as in a sense a physiologist. He watches from day to day the effects produced by the actions of remedies, the effects of disease, or the influence of surgical operations: all of these are experiments on men, produced either by himself or by morbid causes; they are in a sense as truly experimental as those made by the physiologist in his laboratory. Thus we are all working at the elucidation of the same problems, though in different circumstances. This consideration should also induce us to stand shoulder to shoulder in our efforts to resist the assaults of fanaticism or of ignorance, and in the desire to advance the medical and surgical arts.

Although I run the risk of being charged with unduly magnifying the importance of the subject which it is my duty to teach, I must be permitted to say something more about it. Although physiology is interesting as a science by itself, still, students do not sufficiently estimate its importance until they leave its class room, and pass on to the clinical wards. They are not to be blamed for this. Many of the facts brought before them are new, and although they may be interesting they may

have no very evident relation to disease or remedies, and consequently they may be received only as so much material for examination purposes. But when they are led through the clinical wards by a skilful teacher, and are brought face to face with disease, they then recognize the importance of a knowledge of physiology. Disease is a modification of physiological conditions. To appreciate what the modification is, to know its causes, and to know what may possibly restore matters to the normal state, demands a knowledge of what the normal state is. Suppose you are shown a case presenting the symptoms of high temperature, rapid pulse, difficulty in breathing, cough, expectoration of blood and mucus, perhaps delirium, how are you to explain or account for these symptoms? They are not normal. You should be in a position, as regards knowledge, to give a physiological explanation of many of them; at all events your previous knowledge should enable you to appreciate and understand the statements of the physician. This will make a call upon your physiological information. The physician will tell you to listen with the stethoscope to the chest and you will hear sounds. Are these normal sounds or not? You should know the normal sounds of the chest and their conditions before you go to him, and you will then be able to understand why the sounds have the character they possess. He will ask you: "What is the temperature of a healthy man? and what are the conditions which in health maintain the temperature

at nearly a fixed point?" Does not this demand a knowledge on your part of the facts known regarding animal heat, so that you may be able to account for the increase of temperature in the case before you? Then, directing your attention to the difficulty in breathing, and the expectoration of blood, he will ask you what organ is affected? Will not this require you to think of the structure of the lung, of the mechanism of respiration, of the nervous arrangements connected with it, and of the pulmonary circulation? It is not sufficient to call the case one of acute pneumonia, or inflammation of the lungs. Any old woman might tell you that; but you must know, as far as you can, the why and the wherefore of each symptom. You must know the general physiology of the organs before you go to the clinical physician.

In like manner, physiological knowledge will aid you in your studies in the surgical wards, and in endeavouring to comprehend the principles of surgery. It was the practice of the older surgeons—before physiology had taken its place as a distinct science—to begin their course of instruction with a number of lectures on what we would now term physiology. For example, the great John Hunter lectured on the states of matter in the living body, on the vital principle, on the physical, chemical, and vital properties of the blood, on organization, on movements by contractility and elasticity, on the functions of nutrition and absorption,

on the influence of the nervous system, and on animal heat. In recently studying the life and works of this master of science, nothing impressed me more than the constant references he makes to physiological facts and laws as affording an explanation of surgical diseases, and of the processes by which these might be cured. He was a great physiologist, and he brought his knowledge to bear on every detail of his surgical practice. In this respect, many other distinguished surgeons have followed Hunter, so that their success in devising new modes of treatment has been due not only to their anatomical knowledge, or to their dexterity as operators, but also to the insight they had into physiological and pathological conditions. Thus the art of surgery, aided by physiology, has advanced with wonderful rapidity, and it would not be difficult to give illustrations to show that surgical experience has added not a little, in return, to our knowledge of normal processes.

This method of studying disease becomes more striking when it is based not only on physiological, but on pathological knowledge. What is pathology? Strictly speaking, it is the science which treats of morbid function. Therefore, it is the co-relative of physiology, which has to do with normal function. There is a department of pathology, however, called pathological anatomy, which treats of the appearances, either as shown to the naked eye or revealed by the microscope, of morbid or diseased organs

or tissues. Pathological anatomy holds the same relation to normal anatomy as pathology does to physiology. Anatomy and pathological anatomy treat of structure, physiology and pathology treat of function. This is no doubt an artificial classification, implying a distinction between what is normal and what is morbid, whereas we know that, as a rule, so-called morbid processes are merely modifications of normal processes. For practical purposes, however, it is very convenient to use these distinctions. It is interesting to study the gradual development of pathology. In early times, when *post-mortem* examinations were not frequent, disorganization of tissue and of organ was unknown, and even had morbid changes been detected, an erroneous physiology would have given a wrong interpretation of the facts. The older physicians, however, were not destitute of a pathology. They studied symptoms, and often from these alone, and without reference to any morbid changes, they formed pathological theories, many of which are now lost in oblivion. But about the end of last century, anatomy and physiology invaded pathology; physicians made *post-mortem* examinations, and described and figured the morbid appearances they found. Hence arose a new school of pathologists, the members of which connected symptoms with morbid appearances, and attempted to explain these by the application of physiological truths. Morbid specimens were kept in immense numbers, and no doubt they were of great value. But at that time, and for many years

afterwards, it was supposed that diseases might exist without morbid changes in the organs affected, and some were regarded as merely functional without involving any change in the structure of the part. The paroxysms of mania, the depression of melancholia, the symptoms of some kinds of paralysis, the mortal sickness of fever, left apparently no trace behind. But the introduction of the microscope was the next great step in advance. From the time this instrument was made achromatic, a new series of pathological facts have gradually been added to knowledge, and in recent years progress in this direction has been remarkable. Pathology has taken a new start. The pathologist is not satisfied now with a mere naked-eye inspection. No doubt this often tells much, and we do not for a moment disparage the importance of work of this kind. But he goes farther. Aided by all the methods of histological research, the pathologist prepares the organ or tissue in a proper manner, and examines it in thin sections with high microscopic powers. Such a method shows him changes which could not otherwise be seen. The walls of vessels may be atrophied or hypertrophied, the connective tissue may be increased or diminished, cells may be in excessive numbers, some may have disappeared, or cells of a new character may be present. The most remarkable observations of this kind, which have recently come under my notice, are those of Charcot and others in the case of diseases of the spinal cord.

We now know that, in certain obscure forms of paralysis, definite morbid changes may be met with in the medulla oblongata, or spinal cord, even where these may appear perfectly healthy to the naked eye, and that these morbid changes afford a satisfactory explanation of many of the phenomena observed during life. Disease, therefore, has small beginnings. The organ is not involved at once and as a whole : in certain elements of it, of microscopic size, morbid changes originate. Is not this what physiology would lead us to expect? An organ is an assemblage of physiological units, each having a life of its own, and each existing in certain conditions. The life of the organ is the aggregate life of these units. Alter one of these, or alter fifty of them, and you must affect the integrity of the organ. Hence is it that disease originates in microscopic structures. Pathology has made an immense advance in recognizing this, and it is the investigation of these minute changes which is occupying the attention of pathologists all over the world.

But it seems to me that pathology must not pause at this point. The naked-eye examination of a diseased kidney, or of a diseased heart, may no doubt afford a satisfactory explanation of the symptoms observed during life, or the microscopical examination of the cord in a case of locomotor ataxia, or of the medulla in one of glosso-labio-laryngeal paralysis may account for the disorders of sensibility and of motion ; many may be satisfied with this, but it is satisfaction of a somewhat melancholy

nature. The disease has done its worst by destroying the patient's life. The practical mind will naturally ask, what is the cause of these changes?—what is their course, through what successive stages do they pass, and is it possible to interfere with them, or perhaps to arrest them? Here we pass from the region of pathological anatomy to that of pathology. It is in this direction I believe pathology will take the next great step. Now, it is evident that there is little prospect of advancement to be expected merely from clinical inquiry. We rarely see the disease in the early stage; the patient does not die, except from some intercurrent affection, until the changes are so great as to be incompatible with life; and the pathologist can only hazard guesses as to the various stages of change of tissue. Are we then simply to rest where we are and confess our inability to go farther? Are we to say that such and such diseases are the outcome of our artificial way of living, and that they must be borne with resignation, but with no hope from the physician? I feel no sympathy with this view of the matter. Whilst, on the one hand, men will look in vain to medicine for the prolongation of life beyond a certain time, still I feel convinced that there are many diseases which ought to be arrested, and which will yet be arrested, before they destroy life. When we think of the sufferers, and reflect on the loss to the country of lives cut off in their prime, we are bound to spare no effort in the investigation of these diseases. Take a few examples to show the

prevalence of some maladies which one would reasonably expect might in many cases be arrested. Cancer destroys in England alone from 10,000 to 11,000 persons per annum; phthisis, about 50,000, scarlet fever, 24,000, diarrhœa, 20,000, pneumonia, 24,000, typhoid fever, 8,000, rheumatism, 3,000. Now, making allowance for cases of these diseases occurring in aged people, or in those previously weakened by other maladies, do not these figures, taken from the Registrar-General's Report for the year 1874, give a startling notion of the number of deaths in people below middle life, from diseases which ought, I think, to be more amenable to treatment? Many will, no doubt, regard this view of the matter as utopian, and those with most experience will be apt at once to condemn it. Where are we to look for help? Not, I think, from clinical observation alone, nor even when this is associated with the facts of pathological anatomy, but when we call in the aid of experiment. If we are to advance, the experimental method must be applied to pathology as it has been to the other sciences. I know the repugnance many people have to experiments made on animals, but it is chiefly by such that a knowledge of pathological processes is to be gained. No doubt experimental pathology is open to many of the objections urged against experimental physiology. A number of deeply placed organs are not at all accessible, or only made so by injuring other equally important parts; many lesions which occur in man and in animals from unknown causes, cannot at present be reproduced by experi-

ment, and it is difficult to observe in an animal the effects of slight disturbances. Still, already, experiment has thrown light on some questions in pathology. For example, it has made us acquainted with the facts of the life history of many animal and vegetable parasites, with the results of vaccination, with some important facts regarding the inoculation of tubercle and of the syphilitic virus, with the phenomena of inflammation, with the processes of repair going on in tissues, with the changes that ensue in extravasated blood, with the effects of clots plugging up the bloodvessels, with the mechanical causes of dropsies, with the effects upon nutrition of disordered nervous supply, and, lastly, with the relation that is now known to exist between certain epidemic diseases of a most virulent character, and the presence of animal or vegetable organisms in the blood or tissues. I am well aware that such inquiries are difficult, and ought to be taken up solely by those who have been specially trained for the purpose, and who are well acquainted, not only with the methods of physiology, but with physics and chemistry. Nor is it an agreeable kind of work. Still, if it would lead us to the solution of the question of the cause of cancer or of tubercle—if it would aid us in neutralizing the poison of scarlet fever or of typhoid fever, who can estimate the gain it would be to the human race ?

We must all have observed the rapid progress of therapeutics where, from the situation of the organ affected by disease, it can be influenced by the direct application of

remedies, or by surgical interference. Witness, for example, the advanced condition of the therapeutics of diseases of the eye, ear, throat, and female generative organs. This would lead one to hope that the day may come when operations on organs at present under the care of the physician may be performed with success. The effects of local anæsthesia, the splendid results of ovariotomists, the diminished risk of operations by the antiseptic method, all lead us to hope that it may yet be possible to trephine the skull in cases of epilepsy where the nature of the convulsions indicates the seat of the lesion, and perhaps to open the abdominal cavity in various diseases. Again, might not respiration be aided in some cases by altering the composition, pressure, and temperature of the air? might not some method be found out by which at least a portion of the urinary secretion might be drained off by a surface of skin, denuded of its epidermis, and placed in suitable media, thus preventing death when the kidneys for a time ceased to do their work? or, finally, might we not hope to wash out at least a portion of the blood in some zymotic diseases by a process of transfusion, thus getting rid of at least a part of the poison? These views may appear startling and even fanciful, but they may be realized. It is always dangerous to declare anything impossible as regards the invention of new methods.

I think, gentlemen, I have said enough to indicate to you my sense of the importance of pathology. You should take every opportunity of making yourself acquainted with

its facts, not by book-knowledge alone, but also by studying the cases which will be brought under your notice. Every case will add to the fund of your knowledge and experience, and will be a guide to you when, in your after life, you have the great responsibility of treating the sick. I would strongly recommend you also to make yourselves acquainted with pathological histology, as it is taught by Dr. Coats. In other schools, this department has been rapidly developed during the past two or three years, and we must not lag behind. In the struggle for future professional success, you may depend upon it that the most highly qualified will ultimately win the day.

In addition to a sound general knowledge of anatomy, physiology, and pathology, at this stage of your curriculum, you will be expected to know the general character of the substances in the materia medica and their physiological and therapeutical actions. Your previous studies in chemistry and physiology will prepare you for studying the characters and physiological properties of the substances we use as medicines. The physiological actions of medicines have in recent years received much attention, and there can be no doubt that knowledge of this kind is of the greatest importance in medicine, and that the prosecution of inquiry in this direction deserves every encouragement. If we know with some precision the physiological action of a drug, we can give it with more confidence as a therapeutical agent. For example, it has been ascertained that ergotin causes a contraction of the involuntary muscular

fibre found in the walls of vessels, and we may give it therefore in any cases where we wish to cause vessels to contract—thus arresting hæmorrhage, or diminishing the supply of blood in an organ. Hence it may be used as a remedy in hæmoptysis or in cerebral congestion. We have now not a few specific actions of this kind, and it is our hope to find more. The principle of physiological antagonism of drugs is another which promises to be of service. Thus there can be no doubt that hydrate of chloral is a physiological antagonist to strychnia, and therefore it is indicated in cases where tetanic convulsions occur, similar to those caused by strychnia. Some have held that a drug may have a different action in diseased, to what it has in normal, conditions. Within limits, this is very likely, and therefore we require to study the effects of medicines, not only in states of health, but in states of disease. Still I believe this principle has only a limited application. Any change in conditions produced by disease which would interfere with absorption or with elimination might affect the physiological action of a drug, so that the effects would not be the same as when administered to a healthy person, but in most cases the physiological action will be the same. Thus, ergotin would probably cause contraction of involuntary muscular fibre in all cases in which it was administered.

Do not suppose, however, that we use no remedies, the physiological or therapeutical action of which are unknown. There are not a few remedies which produce curative

effects so quickly and certainly as to convince even the most sceptical, and yet we know little or nothing of their mode of action. Take, for example, acute gout, a disease not often seen in hospital practice in Scotland, but not uncommon in England. You see a man in high fever, suffering from great constitutional disturbance, and having the ball of his great toe swollen, red, and acutely painful. After a few doses of wine of colchicum, the symptoms disappear as if by magic. I know no instance of a more striking therapeutical effect. But we cannot at present explain how it acts. It has been shown that its efficacy is not due to any purgative effect, or to any power, yet discovered, of altering the composition of the blood or urine, and its mode of action is unknown. Such, also, are the actions of quinine in malarial diseases and of salicylates in many cases of acute rheumatism. We must not, therefore, refuse to use a remedy because we cannot explain its *modus operandi*. With every desire to strive towards a rational system of therapeutics, we cannot afford to despise the lessons of experience. A young practitioner is often taught that valuable lesson in the earlier years of his practice. He prescribes at first, perhaps, on what might be called the purely scientific method, and saturates his patient with iodide or bromide of potassium, all without any good effect. Friends become restive; the older physician is called in, agrees with the diagnosis of the younger man, and then, if of the old school, writes a prescription containing, perhaps, an unheard-of combination of drugs, which, like a volley of grape-shot, hits

the mark, and the patient begins to recover. Now the older man probably could not give a rational explanation of the action of his prescription, and he would be apt to repress further inquiry by quietly saying that he had often found that prescription to do good in such cases.

As regards this department of your studies, I consider it to be a wise arrangement in our University that you are required in the first instance to devote your attention to materia medica and pharmacy, and afterwards to therapeutics. This is the natural course of things. You will be able to show your knowledge of therapeutics after you have had the opportunity of studying the effects of remedies in the wards of the hospital.

The next and final stage of your work is the study of surgery, medicine, and obstetrics, and I need say nothing regarding the importance of these branches of the medical art. My object in this address has been to impress upon you the necessity of devoting attention to those earlier subjects in the curriculum which are the preparation for, and the basis of, your future studies of diseases and their treatment. To carry out this idea, I hold that the greater part of the first two years of the curriculum should be occupied with these studies, and that the second period of two years should be devoted to medicine, surgery, and obstetrics. I know the tendency there is on the part of teachers to estimate highly the importance of their department, so that the teachers of biology, chemistry, anatomy, physiology, and materia medica claim your entire time

during the first two years, whilst the teachers in what are sometimes called the practical subjects would ask for more time than two years. I sympathize with the latter so far, as it is manifestly impossible to give more than a very brief outline of medicine, surgery, and obstetrics, with the practical study of their applications, in a period of two years; but, on the other hand, we cannot curtail the time for the other studies. The present crowded state of the medical curriculum points to the necessity for five years of study instead of four, and I believe the day is not far distant when some such arrangement must be made.

Your studies in medicine, surgery, and obstetrics will be carried on partly by systematic lectures and partly by clinical teaching. The facilities for clinical teaching in connection with our school are already great, but they will soon be largely increased by the addition to the Western Infirmary of a new wing containing 200 beds. Recently, also, there has been established in connection with the Western Infirmary an out-door obstetrical department, under the supervision of Professor Leishman, which will no doubt not only be a boon to the districts of Anderston and Partick, but also a means by which you will have opportunities of acquiring a practical acquaintance with this department of your profession.

There are two parts of your training which, in my opinion, still demand improvement. The first is the acquirement of a knowledge of ordinary practice by visiting patients at their homes, and the second is a greater facility for the

study of fevers and other epidemic diseases. An out-door dispensary department, properly supervised, would show you the appearances of disease as found in the homes of the poor, and it would teach you many things of importance in general practice which you cannot learn in a hospital ward. Again, fevers and epidemic diseases bulk largely in general practice, and no man should take the responsibility of treating cases until he has seen the course of the disease and been guided in diagnosis and treatment by a competent instructor. Manifestly such cases can rarely be seen in the Western Infirmary, where they may happen accidentally, but to which they are not admitted as regular patients. We must therefore try to devise some method by which our fourth year's students, if they choose, may have an opportunity of studying such cases in our fever hospitals.

Whilst on the subject of clinical study, I may be allowed to remark that I think our authorities, in all hospitals, infirmaries, poor's-houses, and homes, should give facilities for the clinical study of disease under their medical officers. Such can be done, and I believe is done, with every attention to the patients' comfort and the patients' feelings. In such circumstances, the diagnosis and treatment of disease is more likely to be conducted with care than otherwise, and the reflex benefit to the community cannot be over-estimated. Every facility given for the proper clinical training of our medical students will aid in rearing

a race of efficient medical men who will be a practical gain to society.

Before I conclude, I may be allowed to make a few remarks on our medical school. It has never been in so prosperous a condition as it is in at present. We have shared in the general progress of the University. Last year we had close upon 500 students, and I find that there has been an increase of about 50 per cent. during the past seven years. We have £425 per annum available as medical bursaries. These are 15 in number, and may be valuable aids to young men of talent who are filled with the laudable ambition to join the profession. We are doing all in our power to fully furnish our laboratories, and to give thoroughly practical teaching, feeling assured that by doing so we will keep up the high educational standard of the medical schools of our Scotch Universities. Between the sister schools and ourselves there is no feeling except that of a generous rivalry, which can only raise the standard of our work. We have ample opportunities for clinical instruction; and, as I have said, this will soon be largely increased; we have special courses of lectures on diseases of the eye by the Waltonian Lecturer, Dr. Reid, and we have a lecturer on mental diseases in Dr. Yellowlees, who can illustrate his prelections by clinical study in the large asylum at Gartnavel. Thus we have all the resources of a great school. At present, no doubt, many of our departments are crippled for want of

funds. The preparation of specimens for museums, the prosecution of scientific work, the furnishing of laboratories, and the payment of assistants all require money. This cannot be had at present, chiefly owing to the debt on the University buildings, but when this has been cleared off, funds will be unlocked which will be available for University purposes.

It will rest with you, gentlemen, to do your part to make this a great seat of medical learning. The fame of a school depends not only upon its teachers but upon its pupils. Some of you may have thought that I expect too much from you as students, and that I have indicated a standard of excellence to which you cannot hope to attain. After two years' experience of the class of men attending this University, I am sure I do not ask more than you can give. If I have striven to stir up your ambition, it is because I wish the medical graduates of this University not merely to be licentiates to practice medicine and surgery with a minimum qualification, but to be highly educated medical men, who will be an honour to their *alma mater*. Thus will we raise the tone and social position of the medical profession, and send forth a body of graduates from year to year who will command respect, both by their extensive knowledge and by their contributions to the progress of medicine.